

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A fluid cooling heat exchanger including:
 - a primary heat exchanger having a closed circuit for cooling fluid;
 - an air cooler located upstream of the primary heat exchanger;
 - 5 a fan arrangement operable to force air through the air cooler and the primary heat exchanger; and
 - a liquid dispenser operable to dispense liquid into the forced air, said liquid dispensed downstream of the air cooler and upstream from the primary heat exchanger, wherein said air cooler includes a moisture absorbent material that is,
 - 10 in use, maintained moist such that air forced through the cooler is cooled by the action of evaporation prior to being forced over a portion of the closed circuit in the primary heat exchanger.
2. A fluid cooling heat exchanger according to claim 1 wherein the liquid dispenser is activated by a controller that senses ambient environmental
- 15 conditions and causes the dispenser to activate when a predetermined ambient condition is detected.
3. A fluid cooling heat exchanger according to claim 2 wherein the predetermined ambient condition includes an ambient temperature less than a predetermined limit.
- 20 4. A fluid cooling heat exchanger according to claims 2 or 3 wherein the dispenser is activated according to a duty cycle determined by the controller in accordance with sensed ambient environmental conditions.
5. A fluid cooling heat exchanger according to claim 2 or 3 wherein the predetermined ambient condition includes an ambient temperature approaching
- 25 the freezing point of the cooling fluid.
6. A fluid cooling heat exchanger according to claim 2 or 4 wherein the predetermined ambient condition is the temperature of the cooling fluid.

7. A fluid cooling heat exchanger according to claim 2 wherein the liquid dispenser is activated by the controller sensing the temperature of outgoing cooling fluid from the primary heat exchanger and causing the dispenser to activate when the temperature sensed is greater than a first predetermined limit.
- 5 8. A fluid cooling heat exchanger according to claim 7 wherein the liquid dispenser is de-activated by the controller when the temperature sensed is lower than a second predetermined limit.
9. A fluid cooling heat exchanger according to claims 7 or 8 wherein the first predetermined limit is greater than the second predetermined limit.
- 10 10. A fluid cooling heat exchanger according to claim 2 wherein the liquid dispenser is activated by the controller sensing the pressure of outgoing cooling fluid from the primary heat exchanger and causing the dispenser to activate when the pressure sensed is greater than a first predetermined pressure.
- 15 11. A fluid cooling heat exchanger according to claim 10 wherein the liquid dispenser is deactivated by the controller when the pressure sensed is lower than a second predetermined pressure.
12. A fluid cooling heat exchanger according to claims 10 or 11 wherein the first predetermined pressure is greater than the second predetermined pressure.
- 20 13. A fluid cooling heat exchanger according to any one of the preceding claims wherein the liquid dispenser can be activated to permit washing of an external surface of the primary heat exchanger.
14. A fluid cooling heat exchanger according to any one of the preceding claims wherein the liquid is dispensed as a spray of fine droplets.

15. A fluid cooling heat exchanger according to any one of the preceding claims wherein the liquid dispensed impinges upon a surface of the primary heat exchanger causing thermal energy to be removed from the primary heat exchanger.
- 5 16. A fluid cooling heat exchanger according to any one of claims 2 to 15 further including a conduit connected to the liquid dispenser to supply liquid thereto, an electrically controlled valve located in the conduit to selectively permit liquid flow to the dispenser in response to a signal from the controller, wherein the conduit extends substantially upwardly from the dispenser to the valve such that
10 during periods when the valve is closed, any fluid in the conduit between the valve and the dispenser drains through the dispenser outlet.
17. A cooling fluid heat exchanger according to any one of the preceding claims further including a plurality of air inlets and outlets with the fan arrangement disposed therebetween and operable to draw air in through the
15 plurality of inlets and force air out through the plurality of outlets.
18. A cooling fluid heat exchanger according to any one of the preceding claims wherein the fluid passes through the primary heat exchanger in thermally conductive tubing.
19. A cooling fluid heat exchanger according to any one of the preceding
20 claims wherein the absorbent material is moistened with water.
20. A cooling fluid heat exchanger according to claim 19 wherein the water used to moisten the absorbent material is separate from the fluid to be cooled.
21. A cooling fluid heat exchanger according to any one of the preceding claims wherein the moisture absorbent material includes a plurality of fluted
25 apertures where the apertures are less than 7mm in diameter.
22. A cooling fluid heat exchanger according to any one of the preceding claims wherein the cooling fluid is water.

23. A cooling fluid heat exchanger according to any one of claims 1 to 21 wherein the cooling fluid is ammonia.
24. A cooling fluid heat exchanger according to any one of claims 1 to 21 wherein the cooling fluid changes state during operation to effect transfer of thermal energy.
25. A method of converting a cooling system incorporating a first heat exchanger including a fluid cooling heat exchanger where fluid is exposed to air drawn through the heat exchanger by replacing said first heat exchanger with a second heat exchanger including a primary heat exchanger, an air cooler including a moisture absorbent material that is, in use, maintained moist such that air forced through the air cooler is cooled by the action of vaporisation and a liquid dispenser operable to dispense liquid into the forced air stream wherein the fluid in the primary heat exchanger is contained and prevented from exposure to air forced through the air cooler and then subsequently passed through the second heat exchanger, the method including the steps of:
- disconnecting the first heat exchanger cooling fluid inlet and outlet connection;
 - reconnecting the fluid inlet and outlet to the corresponding connection points of the second heat exchanger; and
 - operating the cooling system.
26. A cooling system having a fluid cooling heat exchanger including:
- a primary heat exchanger including a closed circuit for cooling fluid;
 - an air cooler including a moisture absorbent material that is maintained moist for cooling air by evaporation said air cooler located upstream of said primary heat exchanger;
 - a fan arrangement operable to force air through said air cooler and said primary heat exchanger; and
 - a liquid dispenser operable to dispense liquid into the forced air stream;
- wherein

air forced through said cooler is cooled prior to being forced over a portion of said closed circuit in said primary heat exchanger.

27. A method of cooling fluid in a cooling fluid heat exchanger, the method including the steps of:

5 passing cooling fluid of a cooling system through a primary heat exchanger having a closed fluid circuit such that the cooling fluid is contained;

 locating an air cooler upstream of the primary heat exchanger and a liquid dispenser downstream of the air cooler; and

10 causing a flow of air through the air cooler and over a portion of the closed fluid circuit wherein said air cooler includes a moisture absorbent material that is, in use, maintained moist such that the air passing through the moisture absorbent material is cooled by vaporising the fluid contained therein and operating the liquid dispenser to dispense liquid into the forced air stream.

28. A cooling system having a fluid cooling heat exchanger including:

15 a primary heat exchanger including a closed circuit for circulating fluid;

 a secondary heat exchanger including a moisture absorbent material that is, in use, maintained moist, the secondary heat exchanger adapted to provide air cooled by the action of evaporation in communication with said primary heat exchanger; and

20 a liquid dispenser operable to dispense liquid into the forced air stream.